

VOL. IV, PP. 50-51, PL. 17

MARCH 31, 1886

THE
NATIONAL GEOGRAPHIC MAGAZINE

THE MOTHER MAPS

UNITED STATES

HENRY GANNETT



President of the National Geographic Society
WILLIAM H.

VOL. IV, PP. 401-46, PL. 77

MARCH 11, 1893

THE
NATIONAL GEOGRAPHIC MAGAZINE

THE MOTHER MAPS OF THE UNITED STATES.

BY HENRY GANNETT,

(*Presented before the Society January 22, 1893.*)

INTRODUCTION.

We speak of topographic maps and of geographic maps. Both of these classes of maps represent similar features—the drainage and other bodies of water, the relief of the earth's surface, and the artificial features, such as railroads, roads, towns, houses, etc. The distinctions between them are merely those of scale and of area represented. A map on a small scale and covering a large area is commonly known as a geographic map.

Mother maps are those made from original sources of information. Unquestionably they are the maps for the production of which a survey was carried on, while compiled maps are secondary productions, being reduced or changed in certain respects from the mother maps. Topographic maps may be mother maps or compiled maps. Geographic maps are in most cases compiled maps.

Most of the countries of Europe have been surveyed under a uniform plan or system and mother maps produced therefrom. In these cases the mother map is everywhere of uniform quality and character. In the United States, on the other hand, many partial surveys have been made under independent authorities

and of widely differing degrees of accuracy, and the maps resulting therefrom differ in scale and value.

It is my purpose to sketch the principal of these surveys, characterizing the methods employed and the accuracy and value of the maps which have resulted from them, in order to learn what parts of the country have been well mapped, what parts have been indifferently mapped, and what parts have not been mapped at all. Such surveys have been executed under authority of the general government and of state governments and have been carried on by private enterprise.

Surveys of the United States Government.

The Coast and Geodetic Survey.—The most prominent organization under the general government, and that one which is executing the most accurate work, is the United States Coast and Geodetic survey, which, commencing its actual work in 1832, has continued down to the present time. During this period nearly the entire coast line of the Atlantic, Gulf and Pacific, with the exception of the coast of Alaska, has been mapped, together with a strip of inshore topography ranging from half a mile to five miles in breadth. The area of topographic surveys is not extensive, being at the present date only about 34,000 square miles. In addition to this work, triangulation has been extended inland in various directions for a number of different purposes. It has been extended southward along the Appalachian mountains for the purpose of furnishing a suitable control for the work along the southern coast; it has been extended westward from the Atlantic coast in the neighborhood of the 4th parallel of latitude to central Kansas, and from the Pacific coast eastward to eastern Utah for the purpose of ultimately joining together by triangulation the work upon the eastern and western coasts. For assisting in state surveys, triangulation has been done in the interior in many of the states, among which are New Hampshire, Massachusetts, New Jersey, Wisconsin, Indiana, Kentucky and Tennessee. Besides all this triangulation, numerous astronomic determinations have been made in the interior.

The triangulation of this organization is of the highest order of excellence. Topographic details are mapped by the plane-table. The plan-table sheets are in the main made on a scale of 1:10,000, or about 6 inches to 1 mile, and are published on

various scales from 1:10,000 to 1:80,000. Contour lines at vertical intervals of 10 or 30 feet are located on the planimetric sheets. The small scale charts are published in batches, those on the larger scales conveniently in contours.

Geological Survey.—The United States Geological Survey is the only organization which has ever undertaken to map the United States under a comprehensive and well defined plan, and it has surveyed a greater area than any other organization. It was formed in 1870 upon the discontinuance of the three rival western surveys, namely, the Farnsworth, Wheeler and Powell surveys. At first it was restricted in its operations to the public domain, but was soon authorized by law to include the entire United States. The work of topographic surveying on a large scale, with a view to mapping the entire country, was commenced in 1882 and has been prosecuted actively since that time.

The work, wherever practicable, is controlled by triangulation, which, though not of geodetic refinement, is suitable for the control of the maps upon the adopted scales. Where it is not practicable to carry on triangulation for control, traverses are run for that purpose with instruments of considerable power and with all possible precision to prevent the accumulation of sensible error.

A-side from the primary control, location is effected by graphic methods. The planimetric is used for secondary triangulation and for traversing. Heights are measured with the spirit level, by vertical angles, and by aneroid. The maps are now published on two scales, one of 1:62,500, or about one mile to an inch, the other of 1:125,000, or about two miles to an inch. Considerable work has been executed on the scale of 1:250,000, but that scale has been abandoned. Relief is expressed by contour, the intervals ranging from 5 feet up to 200, depending upon the scale and upon the degree of relief of the country.

The Geological Survey has worked in cooperation with some states, namely, Massachusetts, Rhode Island, Connecticut and New Jersey, and has completed the surveys of those states. It has also surveyed large areas in New York, Pennsylvania, Maryland, Virginia and West Virginia, the southern Appalachian region, Louisiana, Texas, Arkansas, Illinois, Iowa, Wisconsin, Missouri, Kansas, and the western states and territories generally. Altogether an area of 470,000 square miles has been surveyed. The maps are engraved on copper. Three plates

104 *Henry Cowell—Mother Maps of the United States.*

are required, the culture, drainage and relief being printed in different colors.

Lake Survey.—The shores of the Great Lakes and of the St. Lawrence river have been mapped, together with a narrow strip of topography, by the organization known as the United States Lake survey, which was under the control of the Engineer corps of the United States army. Besides mapping the shores of the lakes, this organization carried a belt of triangulation from the head of Lake Michigan to that of Lake Erie across the southern end of the peninsula of Michigan, and another strip of triangulation through eastern Illinois to the neighborhood of Vincennes, Indiana, and located by astrometric means a large number of points in the lower peninsula of Michigan. All these determinations of positions were connected directly with section centers of the United States Land survey, to be hereafter described.

The work of this organization was of a high order of excellence, comparable in most respects to that of the United States Coast and Geodetic survey.

Engineer Surveys.—In connection with river improvements, the United States Engineer corps has made surveys of many navigable rivers. In many cases these are merely local surveys covering trifling areas, but in the cases of the lower Mississippi and the Missouri river excellent maps, controlled by triangulation, have been produced.

Army Explorations.—The western part of the United States has, ever since its acquisition, been a favorite field for exploration and survey. For a long time the War department monopolized this field. The explorations began with the famous expedition of Lewis and Clark in the early years of the century, followed by those of Long, Pike and Fremont. Then, in the early fifties, came that remarkable series of explorations known as the Pacific railroad surveys. These were followed by numerous other army expeditions, some of which are of comparatively recent date. Altogether a large number of military parties have traversed the Cordilleran region and each of these expeditions has furnished more or less geographic information.

Their methods of survey were, in nearly all cases, similar. A traverse survey of the route was made, using the compass for directions. Distances were measured by the revolutions of a wheel or by estimates based upon the time of travel. Points off the line were intersected upon and thus located roughly with refe-

ence to the line of travel, and, resting upon this rather imperfect skeleton, the topography in sight of the line was sketched, while that out of sight of the line was often added from the statements of trappers, Indians, and traders. These lines were checked at intervals by astronomical determinations, the latitude being determined by altitudes of the sun or a star, the longitude by noon calculations or lunar distances, or by chronometer.

Many such lines were run in various directions over the Cordilleran region. From such as were at that time available, General G. K. Warren constructed in 1857 the first map of the western United States which was in any way worthy of the name of map.

Nearly all of the areas thus explored have since been resurveyed by more accurate and detailed methods.

Survey of the 40th Parallel.—In 1867 Mr Clarence King, a civilian in the employ of the War Department, organized a survey for the exploration of a strip of country adjacent to the line of the Union Pacific and Central Pacific railroads, from the longitude of Cheyenne on the east to the eastern boundary of California on the west, and about 100 miles in breadth from north to south. This work, which was completed in 1871, comprises an area of about 87,000 square miles. It was published on a scale of 4 miles to 1 inch in approximate contour lines 200 feet apart. The work was controlled by triangulation; heights were measured by barometers and by vertical angles, and sketching was done in note books, the sketches being adjusted to the locations in the office.

Surveys west of the 10th Meridian.—This was the most extensive of the surveys within the Cordilleran region. It was commenced in 1868, and for several years was carried on by traverse methods similar to those followed by the other explorations under the War department, and the maps produced were published on a scale of 8 miles to an inch, the relief being expressed by hachures. In 1872-4-5 the methods of this survey were radically improved. A system of control by triangulation was adopted, the scale of publication was increased from 8 to 4 miles to an inch, and areas, instead of lines of travel, were mapped. This survey was discontinued in 1879. The entire area surveyed is said to have been 361,000 square miles, of which 106,000 square miles was on a scale of 4 miles to an inch, the balance being on that of 8 miles to an inch.

The Hayden Survey.—This organization, which was initially a geologic exploration, was instituted in 1867. No topographic work was done by it until 1871, when certain route surveys were made in Montana, Idaho and Yellowstone park. In 1872 similar surveys were carried on in the same region. Between 1873 and 1876, inclusive, the work of this organization was confined to Colorado and adjacent strips of Arizona, New Mexico and Utah, while in 1877 and 1878 work was done in Wyoming, Idaho, Utah and Yellowstone park. During 1874 and following years the methods of survey were greatly improved. The work was controlled by triangulation originating in measured bases, within which was a secondary triangulation, by means of which nearly all control points were located, traverse being used to locate only minor details of roads, streams, etc. Sketching was done in note books, and the sketching was adjusted to the control in the office. The maps were published on a scale of 4 miles to an inch, in approximate contour lines 20 feet apart. Altogether an area of about 100,000 square miles was surveyed by this organization, which was discontinued in 1879.

Pennell Survey.—This survey originated in an exploration of the Colorado river, commenced in 1867. After the completion of this exploration, systematic work was undertaken in the territory of Utah, and up to the time of the discontinuance of the survey in 1879 about 67,000 square miles had been surveyed, comprising in Utah and the northern part of Arizona. The methods of work were quite similar to those of the Hayden survey, but with this notable exception, that the minor control and the sketching were done upon plan-tables, the sketching being adjusted to the control in the field upon the stations. The maps were published by the present Geological survey on a scale of 1:250,000, the relief being expressed by contours 200 feet apart.

Boundary Surveys.—The boundary lines of many of the western states and territories have been run at the expense of the general government, and in connection with these boundary surveys narrow strips of topography have been mapped.

In 1875, when public attention had become drawn to the gold deposits of the Black hills, an exploration of this region was undertaken by the Indian service under the authority of the general government. This exploration included both the preparation of a topographic map and a geological examination. The

map was produced on a scale of 1 mile to an inch in approximate content lines.

Public Land Survey.—In the latter part of the last century a system was devised for the subdivision of the public lands held by the United States, for the purpose of cutting them up into convenient parcels for sale or other method of disposal. The system thus devised has been extended with little modification over all the states, with the exception of the thirteen original colonies, together with Maine, Vermont, Kentucky, Tennessee and Texas. Many of the states have been surveyed entirely under this system, while the others have been in greater part surveyed.

The method of subdivision is a very simple one, and is learned by every western child in connection with the alphabet. An initial point is selected from which a base line is run east and west and a principal meridian is run north. At intervals upon this base line, ranging from twenty-four miles upward, other lines are run north, known as guide meridians, and at similar intervals on the principal meridian secondary east-and-west lines are run, known as correction lines. The blocks of country thus laid out into approximately rectangular shape are subdivided into approximate squares by running lines northward, eastward, and westward at intervals of six miles, forming what are known as townships. Each township is then subdivided by means of lines run at every mile in both directions, forming sections, each section being approximately a mile square. The north lines are theoretically run on true meridians and therefore converge, the convergence increasing from the base line northward until a correction line is required. Upon the correction line a west start is made, the townships and sections retaining their former bases of six miles and one mile respectively.

The principal and guide meridians, the base lines and correction lines, as well as all other township lines in this work, are run by solar compass, and distances are measured by chain with considerable care. The subdivision of townships into sections is generally done with a compass, and the chaining is executed with less care. The accumulated errors in the survey of a township are thrown into the northern and western tiers of sections, eliminating in the northwestern corner.

In the prosecution of these surveys no attention has been paid to geographic positions. The initial points have been selected arbitrarily, and it is only by connecting these surveys with posi-

108 *Henry C. Bratt—Mother Maps of the United States.*

been determined independently that they have been located. Such determinations have been made in abundance by one means or another, and they are well distributed; so that for maps of small scale there is no difficulty in locating these surveys.

As these surveys have been made merely for the purpose of subdividing the land, little attention has been directed toward making them available for the production of maps. The instructions under which they have been made, however, require that the points of crossing of all streams by the lines of survey be noted, together with the intersections of the streams; that all streams above a certain breadth, as well as the borders of all lakes and ponds, be traversed; and that the limits of all swamps and marshes and timbered lands be noted. Had these instructions been everywhere carried out a large amount of geographic information would have been gathered; but unfortunately they have not been fully carried out, and hence the township plates differ greatly in the amount of information which they present. These plates are made on a scale of 2 inches to a mile, a scale many times greater than the degree of detail upon them requires. From these plates, with the addition of information from other sources, the General Land office prepares and publishes a series of very useful state and territorial maps on scales ranging from ten to eighteen miles to an inch, and a map of the United States upon a scale of about 40 miles to an inch.

There is another group of maps published by the general government, the material of which is, in the main, compiled, but which contains certain elements of originality. These are the postal-route maps which are prepared by the Post-office department for illustrating the location of post-offices and the lines of transportation of mails. The natural features of these maps are, of course, compiled. The boundary lines of counties, on the contrary, are in the main laid down directly in accordance with statute. The location of railroads is effected mainly by means of plots furnished directly from the railroad surveys, and the location of post-offices to an corresponding measure derived from similar sources.

With the exception of a few minor matters, the above list covers the survey work and the sources of geographic information furnished by the general government. We turn next to the work done by the various state governments.

MAPS BY STATES

New Hampshire.—This state in 1857 issued a map of the state, which it intended the preparation of at a previous time, but which was effected too late, however, by accident, as the original maps were being made. A number of these maps of the state were obtained from the First of August past, and from these surveys and in those were plotted traverses or roads which had previously been established by private enterprise. Upon this sketch an accurate profile was constructed by means of straight lines connecting the points of the profile. The result of the compilation of the first supplement to the former map was published under the title "A Map of New Hampshire Surveyed by the State Surveyor." This map was printed on a scale of 2 miles to the mile, with a horizontal interval of 100 feet. It was sold at \$4.50.

New York.—From 1857 to 1861 the state of New York conducted a survey under Mr. J. T. Gardiner. By this survey and by the compilation of a local decree, a map was prepared, but little printing had been done. The state map is a edition of many years ago, and is known as the Adirondack survey, which was undertaken with the purpose of mapping the Adirondack region. No results, however, have been published beyond the positions of a few prominent peaks and a large number of unascertained peaks.

Pennsylvania.—In Pennsylvania a small sum of money has been expended in topographic surveys for specific purposes, but there have been no large-scale maps and no elevations. In character they are, however, of a good proportion. Most of them are on the scale of 1 mile to the mile, with an interval of 100 or 200 feet.

Wisconsin.—In Wisconsin a map was drawn in the south-western part of the state by the state geological survey. This work was based on the triangulation of the United States Coast and Geodetic Survey. The Land office plans were used, and the relief was expressed by 50-foot contours.

Minnesota.—Most of the area of Minnesota has been mapped by the state geological survey on a scale of 4 miles to the mile, or a reduced ratio. The longitudinal extent of this map was determined by the surveys of the General Land Office, the vertical element being supplied from the profiles of sections, not supplemented by aneroid measurements.

Kentucky.—In the maps of many of the counties of Kentucky the state map is used. The state

They were soon prepared for trunks of 100 yards. These, though but one-half of a mile in length, are published in full at \$1.00 to \$1.50.

California.—In 1849, 1850, and 1851 the state of California, then a military reservation, was divided into several regulated districts and surveys made to determine the location and boundaries of the various tracts. It is evident that in a large part of the country the land was supposed the greater portion lying on a scale of one hundred miles. At a small area about the Bay of San Francisco was a scale of 200 miles to the inch. The scale of 100 miles was also expressed by hand maps.

New Jersey.—No early state where a line for this could be put into operation is Pennsylvania and New Jersey. In 1837 the state commissioners engaged for a map a contractor with the price of \$100,000 a mile, and by methods very similar to those adopted in the original survey of the United States. The work was discontinued by triangulation, to be then executed by the U. S. Surveyor's Coast or Boundary survey and supervised by the State Surveyor.

The contractor was compelled by a series of traverses to make his lines conform to the level and vertical lines of the existing map. He paid, however, on account of 400 miles to an amount of 400,000 acres of 10 and 20 feet. When the state was a half surveyed the United States Surveyor's survey was taken over, carried the work through to completion upon the same probability the same to check with the state boundary.

LITERATURE

In the preparation of the report of the government after the opening of the entry, it would be best open for private enterprise, and to a certain extent it has done so, but with little success. Maps have been produced by private publishers, but few, if any, in the northern states, and none in the southern states. The author has these maps has been unable to procure surveys of the northern states. These maps are good enough and can be characterized in a very few words. They are essentially the duplicates of those of the U. S. Surveyor's, though they are better. They cover the states of Connecticut, New York, and that portion of the state of New Jersey. Sections are but rarely represented in relief especially with

Most of the functions of the country have been left to the
local church to administer. This includes all of the financial and
spiritual needs of the church. The pastor is the spiritual leader
of the church and is responsible for the spiritual well-being of the
members of the church. He is also responsible for the moral and
spiritual growth of the church members. The pastor is also
responsible for the spiritual growth of the church members.

There is one condition on the effect of a letter to the US and
the UN Security Council that would allow us to take an option
to veto for them on the 14th of April if they had not done so by then.
The thing that would trigger the right to veto is if
what happened in Libya is an attempt to "further this aggression"
which is in article 39 of the UN Charter. The US has argued
that what happened in Libya was an attempt to further
the aggression against Libya although it is not clear that they have
any proof for that. At the moment there is no right to veto
in article 39 of the Charter.

The first article of the statement of our theory, entitled part I of the constitution, speaks about the way that their is to be a non-territorial division of the country. I think that it is a good idea to keep it as it is, but I would like to add some changes as I prefer to speak of the people, or at least the "I", as political entities rather than territorial ones, except of course when talking about the organization of the New York City Government, where I believe that the "I" is more appropriate. I also prefer to speak of the "I" as the separate districts, and not of the "I" as the total independent city, even though I think that it is a good idea to keep the "I" as the total entity, as I think that it does not make sense to have two different names for the same thing.

The former type is a characteristic of the prairie and savannah. It consists of a small number of single-line military. It contains, therefore, throughout all the stations, which are numerous for the country, a kind of a map of the Eastern States. So far I go in detail, but I do not suppose that the same area I am now in is repeated in two or three of the stations, thus affording opportunities for seeing on between two and three miles, the 4 quadrilaterals the latter are given in the form, with the topographical features of each as added for the purpose of aiding another to find it. But the topographical features, however, are not of much use.

ԵՐԱՎԻՇ ՎԱՐԴԱ Ր ՏԱՐ Մարտ

I propose to close by the following modest but final suggestion, since with my exit there is no proposal to be expressed by the author.

The Hydrographic Map of the United States.

It will be worthy of notice presented at this time an estimate of the area of the country which can be mapped from existing hydrographic maps. I do so upon different bases.

The areas which I have in mind are 1) 2.45 million square miles, 2) 1.8 million square miles, 3) 1.6 million square miles.

The scale of 1 mile to one minute for 100,000 square miles can be too well, or more correctly, of the area of the country which we expect to be over 400,000 square miles. This area includes the United States states of Massachusetts, Rhode Island, Connecticut, & New Jersey and parts of the northern other states, mostly in the north. It includes a narrow strip of territory lying along the sea in Lake Ontario and the Mississippi and Mississippi River. Two-thirds of this area is the work of the United States Hydrographic Survey, the balance being made up of that of the United States Coast and Geodetic Survey.

The last scale of 1 mile to one mile per area of 400,000 square miles has been suggested by the following survey. No work is listed to represent that portion that would have been surveyed by other organizations. This area is widely scattered over the country. On the same, therefore, an area of 400,000 square miles, or between 8 million and one-sixth of the area of the country can be mapped.

The scale of 4 miles to one minute for the work of several organizations or the work of the exploration of the 40th parallel, 1) Mayhew, Powell and Northern Triangular metric surveys, 2) Dalek's survey, the 4-mile work of the Wheeler survey, and the 4-mile work of the United States Geodetic Survey. The work of these organizations for the most part follows the river systems, and all, 100,000 square miles. All the areas are in the 40th degree.

The area in the United States which can be mapped on a scale of 4 miles to one mile is, therefore, 920,000 square miles, or between one-third and one-fourth of the area of the country.

The first 3 maps of this area are all of such character as to furnish material for representing all the three kinds of topographic maps—the hydrographic map, the topographic map, and the geological map. They include most of those parts of the country which lie between 40° and 42° latitude and 70° and 80° longitude.

Out of this region, with the exception of 10,000 square miles included by the Wheeler survey, the rest of this area can be expressed quantitatively by contours.

The standard patterns which are adopted for smaller areas have been considerably varied in the more fully developed and extensive except for certain less important areas where standard areas at all will be found enough to be subdivided. At the far larger proportion of the extent of land have been left to be mapped by the original surveyors. In these latter geographic relief cannot be fully shown.

The size of 5 miles by 5 miles, or 1,000 square miles, is admitted to be areas above mentioned can be mapped. Of the area, 1,000 square miles are furnished by the maps of the U. S. Land Office and 100,000 square miles by county maps of the New England states, both of which classes of maps show no roads. 100,000 square miles are supplied from the surveys of the General Quartermaster, were taken over by his Office. The remaining areas in the state maps from various sources. On the present, therefore, it may be thought that 100,000 square miles of nearly four-sixths of the country can be presented in the topographic evolution.

A reduction of the size to 15 miles to the side, or about 2,250 square miles, appears to fit the area, possible to map. It will only touch parts of the southeastern states we are not already in, California, a portion of Texas, and the trifling areas in the Cordillera region. The south eastern states are not represented on this scale by the aid of any of the railroad maps nor maps of the United States Government made by the United States Coast Survey during the civil war the exception of North Carolina, in which I find soap W. L. Kerr and others.

A compilation from railroad surveys has been made of Texas which, excepting for the western part of the state will answer for the state. In the Cordillera region, Bobo's State Survey, not included in later maps has been run over so largely by army

A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.

Legends

At present, an area of about 2,250 square miles is to be the pattern throughout, and have besides Alaska, about 225,000 square miles which is too little to be represented on a scale of 1 mile to the inch.

Much of this is covered as follows. It is evident to be often difficult to estimate the surface as we have done above. Many years ago when the railroad which was chosen for construction had changed greatly. This is particularly the case in the west, where

III. *How to Make Use of the Data*

and the present status of employment has been given to the work of the Survey. We will keep the Survey's statistics.

To bring the situation about up to the needs of the country, additional maps are being prepared to cover the areas now left to the use of great service. These areas are indicated below:

SUMMARY

Ninety-five percent of the men of the United States
Anchors have been surveyed by the government
with the exception of a paper map made in 1900 or earlier
by other organizations or private parties. In many instances
the usefulness of these papers is questionable because they
are surveyed. The other types of data listed are those I think
of interest.

The area to be covered by the various 1:100,000 scale maps of the
United States is limited by the boundaries of the states. These boundaries
are not to be considered as dependent on areas delineated
in the paper map. They are also shown, as far as they are the
present boundaries of the United States according to law.

The scale of 1:100,000 covers 10 miles to one mile, but
is too large for the larger areas groups for mapping the earth
and it is there necessary to know how much of the country
can be mapped on this scale as I will be giving a detailed
description of the information necessary for making a world-wide
map of the world. These areas may have to be eliminated. They
are:

Northern Mexico

Neckarothick - State of New York

South Carolina

Western Idaho - South of Montana

The Cascades and Coast Range of Oregon, Washington

Western North Dakota and South Dakota

Western Texas and Southeastern New M-

Writings, Speeches and Addresses of the First President of the Commonwealth of Massachusetts.

11

116 *Henry Gannett—Molter Maps of the United States.*

The territory of Alaska is still in the exploration stage. Its condition, as regards our geographic knowledge of its area, is quite similar to that of the Cordilleran region half a century ago. The shore line has been explored and laid down upon charts in its approximate position, and a part of the intricate shore line of southeastern Alaska has been mapped with some accuracy. The interior of the territory has been traversed by a number of expeditions, and thus a few routes have been surveyed; but far the greater part of the interior is still utterly unknown.

